QUIZ: Mathematical Problem Solving

1. A vial contains 100 mCi of an unidentified radionuclide, at 10 a.m. Thursday. At 10 a.m. Friday, the activity has decayed to 25 mCi. What is the half-life of the unidentified radionuclide?

   a) 24 hours
   b) 12 hours
   c) 4 hours
   d) 100 hours

2. A vial contains a mixture of 20 mCi of ^{124}I (half life 4 days) and 6 mCi of ^{131}I (half life 8 days). What will be the activity in the vial 8 days from now?

   a) 5 mCi
   b) 3 mCi
   c) 8 mCi
   d) 13 mCi

3. For a T_{phys} = 1 year and the T_{biol} = 10 years, what is the T_{eff}

   a) 1.10 years
   b) 0.909 year
   c) 9.0 years
   d) none of the above

4. A collimated beam with 3 half-value layers of lead in front of it gives a reading of 10 mR/hr. If 1 half-value layer is removed, what would be the intensity reading?

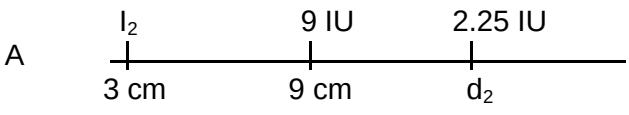
   a) 5 mR/hr
   b) 20 mR/hr
   c) 3/2 x 10 mR/hr
   d) none of the above

5. A collimated beam has initial intensity I_1=10 mR/hr. What would be the intensity I_2 if 3 half-value layers of lead (density 13.6 g/cc) were placed between source and detector?

   a) 3.33 mR/hr
   b) 1.25 mR/hr
   c) 10 x 3 mR/hr
   d) none of the above

6. Refer to the diagram below and assume an uncollimated point source at point A. Calculate value for I_2

   a) 9 IU
   b) 81 IU
   c) 27 IU
   d) 243 IU



7. Refer to the diagram above and calculate value for d_2.

   a) 16 cm
   b) 18 cm
   c) 22.5 cm
   d) 324 cm

8. At some point in time a source has an activity of 1,000 mCi. At a later point in time the activity is 62.5 mCi. The half-life is unknown. How many half-lives have elapsed?

   a) three
   b) four
   c) five
   d) can't be determined from the data provided

9. A Tc-99m source has activity = 100 mCi at 9 AM today. What will be activity at 5:46 PM?

   a) not enough information to solve problem
   b) 40.0 mCi
   c) 36.3 mCi
   d) 37.63 mCi
   e) none of the above

10. For a T_{phys} = 46 d and a T_{eff} = 14 d what is T_{biol} ?

    a) 32 d
    b) 60 d
    c) 15.94 d
    d) 20.12 d
    e) <14 d

11. The t_{phys} of Ga-67 is 3 days. If t_{eff} = 1.5 days, what is t_{biol}?

    a) 1.5 days
    b) 4.5 days
    c) 0.67 day
    d) none of the above

12. At 1 cm from a point source, the intensity is 1000 R/hr. At what distance from the source would the intensity be reduced to 1000 mR/hr?

    a) 100 cm
    b) 1000 cm
    c) 31.62 cm
    d) 31.72 cm

13. For Tc-99m, what fraction remains after 19 hours?

    a) 6/19
    b) $(6/19)^2$
    c) $(0.5)^{6/19}$
    d) $(0.5)^{19/6}$

14. The first half-value layer (HVL) for a polychromatic beam is 3mm. of Al. The second HVL is _____ the first.

a) Less than
b) Equal to
c) Greater than
d) 1.44 x first HVL

15 A narrow beam of monoenergetic photons is directed upon a 20 cm water phantom from a source 50 cm above the surface. The HVL is 10 cm of water. The photon flux at the bottom of the phantom relative to that at the surface is about _____ %

a) 6.2
b) 12.5
c) 25
d) 50

16. The gamma ray dose rate constant Γ for a particular isotope is $\frac{1.65\ R \times cm^2}{hr \times mCi}$.

If a 6 mCi source is held at a distance of 8 cm for 10 hours, what would be the absorbed dose in Rads?

a. 12.375
b. 1.547
c. 0.22
d. 1.76

17. A source has an intensity of 4 mR/hr. A barrier 4 cm thick is placed between the source and the detector and the reading drops to 0.4 mR/hr. What is the half-value layer of the absorber?

a. 0.4 cm
b. 1.2 cm
c. 4 cm
d. 20 cm

18. Using the same information in problem 17, calculate the tenth value layer.

a. 0.4 cm
b. 1.2 cm
c. 4 cm
d. 20 cm

19. If a certain ^{131}I compound has a t_{biol} of 24 days, what is the mean effective life.?

a. 8 days
b. 6 days
c. 8.7 days
d. 24 days

20. If the decay constant of a commonly used isotope is 0.05210 hr^{-1}, what is the isotope?

    a. Cr-51
    b. I-123
    c. Tc-99m
    d. Kr-81m

21. A sample has a count rate of 3.7 x 10^8 c/sec in a detector. The detector efficiency is 42%. How many mCi are present?

    a. 1.55
    b. 10
    c. 4.2
    d. 23.8

22. If a 1 cm thick lead absorber is placed between a point source and a detector, the intensity of the beam is reduced to 42% of its initial value. What is the half-value layer of lead for this isotope?

    a) 1.25 cm
    b) 0.80 cm
    c) 0.78 cm
    d) 1.27 cm
    e) none of the above

23. Two camera heads are alike except that the one employs a 10-inch diameter scintillation crystal and the other a 15-inch diameter detector. The collimators for the detectors are identical in all parameters (length, focal length, etc). The counting rate obtained with the 10-inch head from an extended source compared to that obtained with the 15-inch head with comparable collimation is:

    a. 1.5 times as great
    b. 0.667 times as great
    c. the same
    d. 2.25 times as great
    e. 0.4444 times as great

24. A radioactive source has a dose rate of 40 mR/hr at a distance of one foot. At what distance from this source would a technician working 40 hours per week for 50 weeks per year receive a total dose of 5,000 mR?

    a. 10 feet
    b. 6 feet
    c. 4 feet
    d. 3 feet